

We claim:

1. A method for a distributed beaconing period protocol for a device in an ad hoc network (300) of devices (301), comprising the device (301) performing the steps of:
dividing (502) the medium access time into a sequence of at least one contiguous superframe (102) beginning at a Beacon Period Start Time (101);
partitioning the superframe (102) into a slotted Beaconing Period BP (104), having a plurality of contiguous beacon slots (105), followed by a data transfer period; and
associating with at least one of an existing ad hoc network BP(505) or creating a new ad hoc network BP (503) as the BP of the device.
2. The method of claim 1, further comprising the steps of:
if the BP of the device is not protected in at least one neighboring BP, protecting (506) the unprotected BP in the at least one neighboring BP; and
once the BP of the device is protected, operating normally (507) (600).
3. The method of claim 2, wherein the protecting step further comprises the step of including a first reservation for the own BP in the own beacon of the device in the at least one neighboring BP.
4. The method of claim 3, wherein the reservation is a DRP reservation of type BP and priority = BP.
5. The method of claim 3, wherein the first associating step further comprises the steps of:
choosing an empty slot (505) of the BP of the device; and
beaconing (505) an own beacon of the device in the chosen empty slot.
6. The method of claim 5, further comprising the step of including information regarding the beacons of other devices in the own beacon of the device.
7. The method of claim 6, wherein the protecting step further comprises the step of including a second reservation in the own beacon of the device to announce the BP of said other devices.

8. The method of claim 7, wherein the second reservation is a DRP reservation of type BP and priority = BP.

9. The method of claim 3, wherein the associating step comprises the steps of: scanning the medium to detect at least one BP during the at least one superframe (502);

if at least one BP is not detected, starting a new BP as the BP of the device at a beacon period start time calculated in a pre-determined manner; and

if at least one BP is detected, deciding to perform one of the steps of:

- i. joining at least one of the at least one detected BP as the BPs of the device (505), and
- ii. starting a new BP as the BP of the device at a beacon period start time determined in a pre-determined manner (503).

10. The method of claim 9, wherein the associating step further comprises the steps of:

choosing an empty slot of the BP of the device (505); and

beaconing an own beacon of the device in the chosen empty slot (505).

11. The method of claim 10, further comprising the step of including information regarding the beacons of other devices in the own beacon of the device.

12. The method of claim 8, wherein the protecting step further comprises the step of including a third reservation in the own beacon of the device in the neighboring BPs to announce the BP.

13. The method of claim 12, wherein the third reservation is a DRP reservation of type BP and priority = BP.

14. The method of claim 3, wherein the step of operating normally C comprises the steps of:

receiving beacons over the medium (601); and

when a beacon comprising a DRP reservation of type BP is received, performing the steps of-

- scanning for a new BP (603), and
- when a new BP is detected, protecting the new BP (602).

15. The method of claim 14, wherein the protecting steps further comprise the step of including a fourth reservation in the own beacon of the device to protect the BP.

16. The method of claim 15, wherein the fourth reservation is a DRP reservation of type BP and priority = BP (602).

17. The method of claim 14, wherein the step of operating normally (507) (600) further comprises the step of a device optionally switching BP if two or more BPs co-exist (605) (606) (607).

18. The method of claim 17, wherein the step of switching BP by the device further comprises the steps of:

including a special switching announcement field in a beacon to announce a new BP (606); and

beaconing for at least a predetermined announcement number of consecutive superframes with the beacon including the special switching announcement field (605).

19. The method of claim 18, wherein the beaconing step further comprises one of the steps selected from the group consisting of:

(a) performing the steps of –

- including a DRP reservation of type BP to protect the new BP, if the new BP is not already protected (607), and
- stopping transmission of the beacon, if the new BP is already protected; and

(b) transmitting a beacon in the new BP.

20. The method of claim 18, wherein the step of operating normally (507) (600) further comprises the steps of:

when a beacon comprising a BP switching announcement of another device is received, performing the steps of -

- scanning for a new BP (603), and
- when a new BP is detected, protecting the new BP (602).

21. The method of claim 2, wherein the operating normally step (507) (600) further comprises the step of terminating the BP.

22. The method of claim 2, wherein the operating normally step (507) (600) further comprises the step of clearing a DRP BP reservation of the device when no beacons are received during the BP for a pre-determined clearing number of consecutive superframes.

23. The method of claim 14, wherein the step of operating normally (507) (600) further comprises the step of when at least two BPs collide, until there are no longer any colliding BPs, repeatedly performing at least one of the steps selected from the group consisting of:

- (a) performing the substeps of:
 - searching each colliding BP for enough empty beacon slots for the devices of an other colliding BP (608), and
 - moving at least one colliding BP to a non-colliding beacon period start time (604); and
- (b) performing the substeps of –
 - searching the superframe for enough empty beacon slots for the own BP, and
 - and moving the BP to the empty slots in the superframe (608).

24. The method of claim 23, wherein the step of operating normally (507) (600) further comprises the step of when an existing DRP reservation collides with a BP, moving the colliding DRP reservation to a non-colliding time (608).

25. The method of claim 23, wherein the step of operating normally (507) (600) further comprises the step of when an existing DRP reservation collides with a BP, moving the BP to a non-colliding time (604).

26. The method of claim 1, further comprising the step of each device (301) of the ad hoc network of devices (300) beaconing in the same BP, by performing one of the substeps selected from the group consisting of:

- beaconing in parallel in each BP of each device (301) of said network of devices (300); and
- switching an own BP to beacon in a same BP as other devices (301) of said network of devices (300).

27. The method of claim 26, wherein a device(301) that does not have to switch its BP is chosen in a distributed way based on an identifier of each device (301) of said network of devices (300).

28. The method of claim 26, wherein a device (301) that does not have to switch its BP is chosen in a distributed way based on the number of occupied beacon slots in the BP of each device (301) of said network of devices (300).

29. The method of claim 26, wherein a device (301) that does not have to switch its BP is chosen in a distributed way based on the size of the portion of the superframe (102) that is reserved by the beacons in a BP of a device (301) of said network of devices (300).

30. The method of claim 1, wherein each device (301) of said network of devices (300) may beacon in a different BP.

31. A distributed beaconing apparatus for an ad hoc network device, comprising:
a receiver (404) for receiving beacons (105) and data transfers from other ad hoc network devices (301);
a transmitter (401) for transmitting own beacons of the device and data;
a distributed beacon period processing component (403) that processes received beacons and own beacons of the device (301) for transmission;
a controller (402) operatively coupled to said distributed beacon processing component (403) and configured to direct said processing component to -
- i. divide the medium into a sequence of superframes (102) comprising at least one slotted beaconing period (BP) (104) and including a certain number of beacon slots each having a pre-determined beacon slot length (202), said slotted BP (104) being followed by a data transfer period (103) , and
 - ii. associate with at least one of an existing ad network BP and a new ad hoc network BP as the BPs of the device (301).
32. The apparatus of claim 31, wherein said controller (402) is further configured to direct said distributed beacon processing component (403) to:
- iii. protect the BPs of the device in neighboring BPs (506); and
 - iv. operate normally, once the BP of the device is protected (507) (600).
33. The apparatus of claim 32, wherein the controller is further configured to:
choose an empty slot of the BP of the device; and
beacon an own beacon of the device in the chosen empty slot.
34. The apparatus of claim 32, wherein the distributed BP processing component protects the BP of the device by including a DRP reservation of type BP and priority = BP in the own beacon of the device to announce the BP to neighboring devices.
35. The apparatus of claim 34, wherein the distributed BP processing component is further configured to include information regarding the beacons of other devices in the own beacon of the device.

36. The apparatus of claim 35, wherein the controller (402) is further configured to control the distributed BP to:

- scan the medium to detect at least one BP during the at least one superframe (502);
- if at least one BP is not detected (503), start a new BP as the BP of the device at a beacon period start time calculated in a pre-determined manner; and
- if at least one BP is detected, decide to perform one of (504):
 - i. join one of the at least one detected BP as the BP of the device (505), and
 - ii. start a new BP as the BP of the device at a BP start time determined in a pre-determined manner (503).

37. The apparatus of claim 36, wherein for normal operation (507) (600) the controller (402) is further configured to:

when a received beacon includes at least one of a DRP reservation of type BP and a BP switching announcement for an other device

- scan for a new BP (603), and
- when a new BP is detected, protect the new BP (602);

when a beacon of a neighbor is received, protect the neighbor BP (602);

when the device switches BPs announce in the own beacon of the device, for a predetermined announcement number of consecutive superframes, that the device is switching BP (606);

optionally switch BPs if two or more BPs co-exist (608);

terminate the BP;

clear a DRP BP reservation of the device when no beacons are received during the BP for a pre-determined clearing number of consecutive superframes.

when at least two BPs collide, until there are no longer any colliding BPs repeatedly perform at least one function selected from the group consisting of search each colliding BP for enough empty beacon slots for the devices of an other colliding BP; and move at least one colliding BP to a non-colliding beacon period start time (608); and

when an existing DRP reservation collides with a BP, moving the colliding DRP reservation to a non-colliding time of the data transfer period (604).